

Public Meeting to Discuss “Weekend Effect” Research

June 23, 1999

AMBIENT DATA ANALYSES

Hien Tran & Jeff Austin

- Weekend effect of ozone
- Diurnal patterns of ozone and precursors
- Weekday/weekend differences in reactivity
- Day-of-week pattern of PM10

The “WEEKEND EFFECT” of OZONE

Hien Tran
23 June 1999

*Air Resources Board
California Environmental Protection Agency*

Quantification of Effect

- Austin and Tran (1999) Paper
- Robust statistics on daily max
 - » seasonal and trend adjustments, paired days
 - » significance tests, spatial analysis
- Pre- and Post-CBG
 - » South Coast: 1992-94, 1996-98
 - » SF Bay Area: 1992-95, 1996-98
 - » Sacramento: 1992-95, 1996-98

Day-to-Day Changes

- Monday through Friday
 - » no change
- Friday to Saturday
 - » increase significant for SC and SFB
 - » no change for Sac

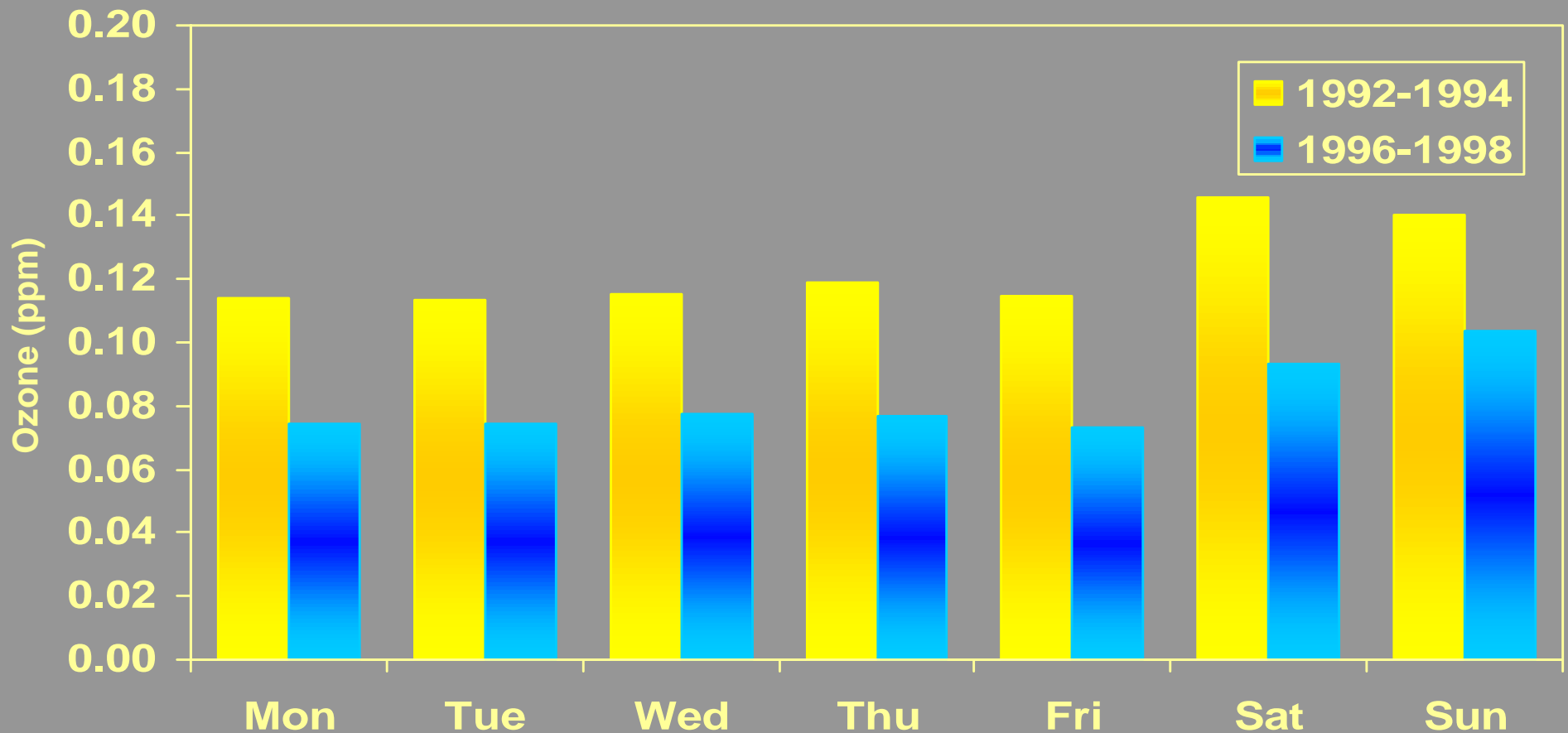
Day-to-Day Changes, Cont.

- Saturday to Sunday
 - » no change pre-CBG
 - » some sites increase post-CBG
- Sunday to Monday
 - » decrease significant for SC and SFB
 - » no change for Sac

Other Observations

- **CBG Effect**
 - » ozone drops for all days, all sites
 - » less benefit on Sunday for SC and SFB
- **Weekend Effect**
 - » strongest at urban sites
 - » more mild far downwind
 - » becomes stronger post-CBG

Average Peak Summer Ozone Concentration by Day of Week Azusa



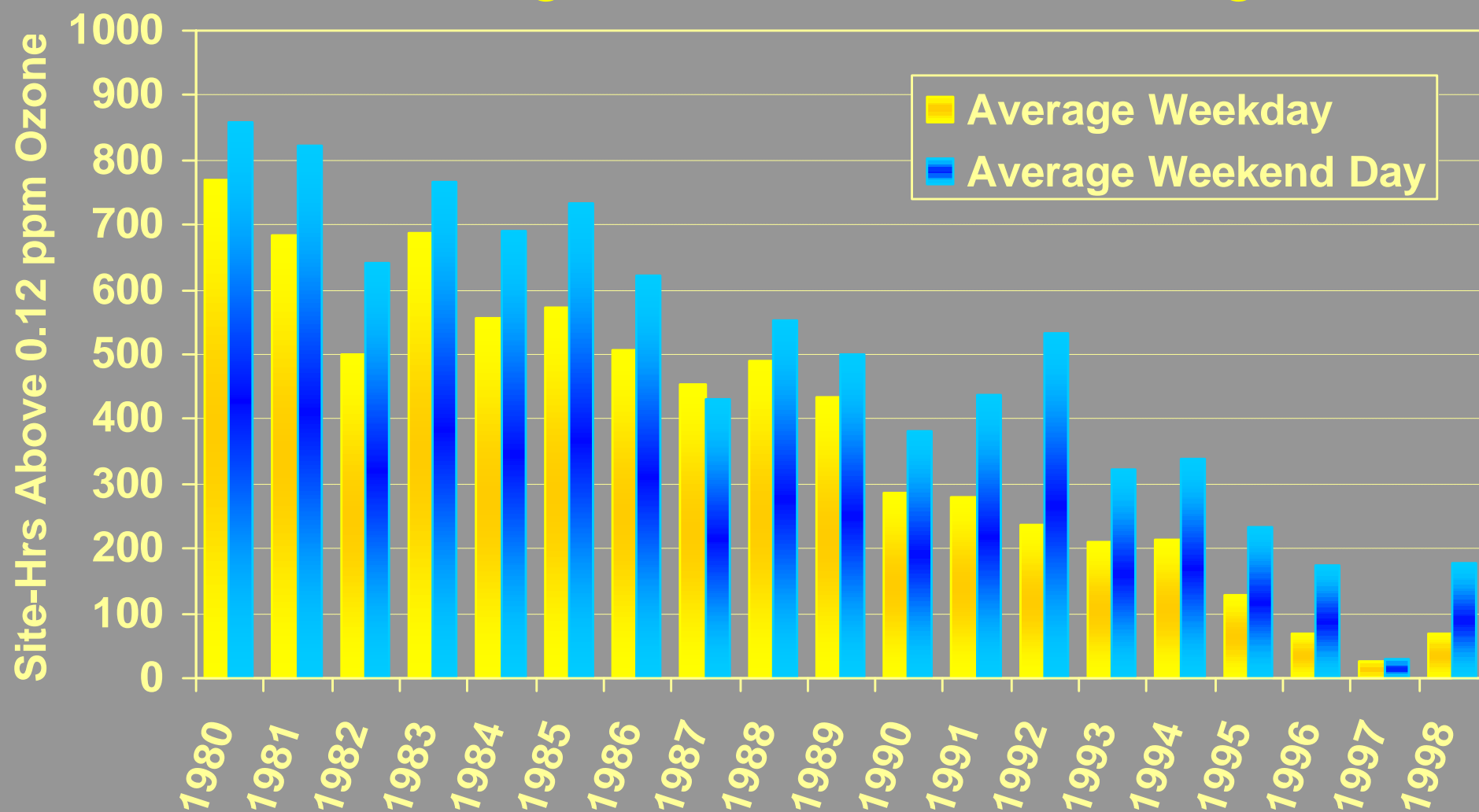
Conclusions

- Ozone control program less effective on weekends in SC and SFB
- No weekend effect in Sac
- Pre-CBG: Saturday effect
- Post-CBG: Sunday effect

Possible further study

- Extend work to other years
- Long term ozone trends, shifts

South Coast Ozone Weekday and Weekend Day



Diurnal Patterns of Ozone and Precursors

South Coast, 1994 and 1998

Jeff Austin

Data

- South Coast, 1994 and 1998, May–October
- 26 sample days per day of week
- 29 ozone monitors
22 NO_x
20 CO

Methodology

- One set of profiles per site, for each year
- Weekdays (Monday through Friday) averaged together to get single profile
- Examined individual daily profiles for outliers

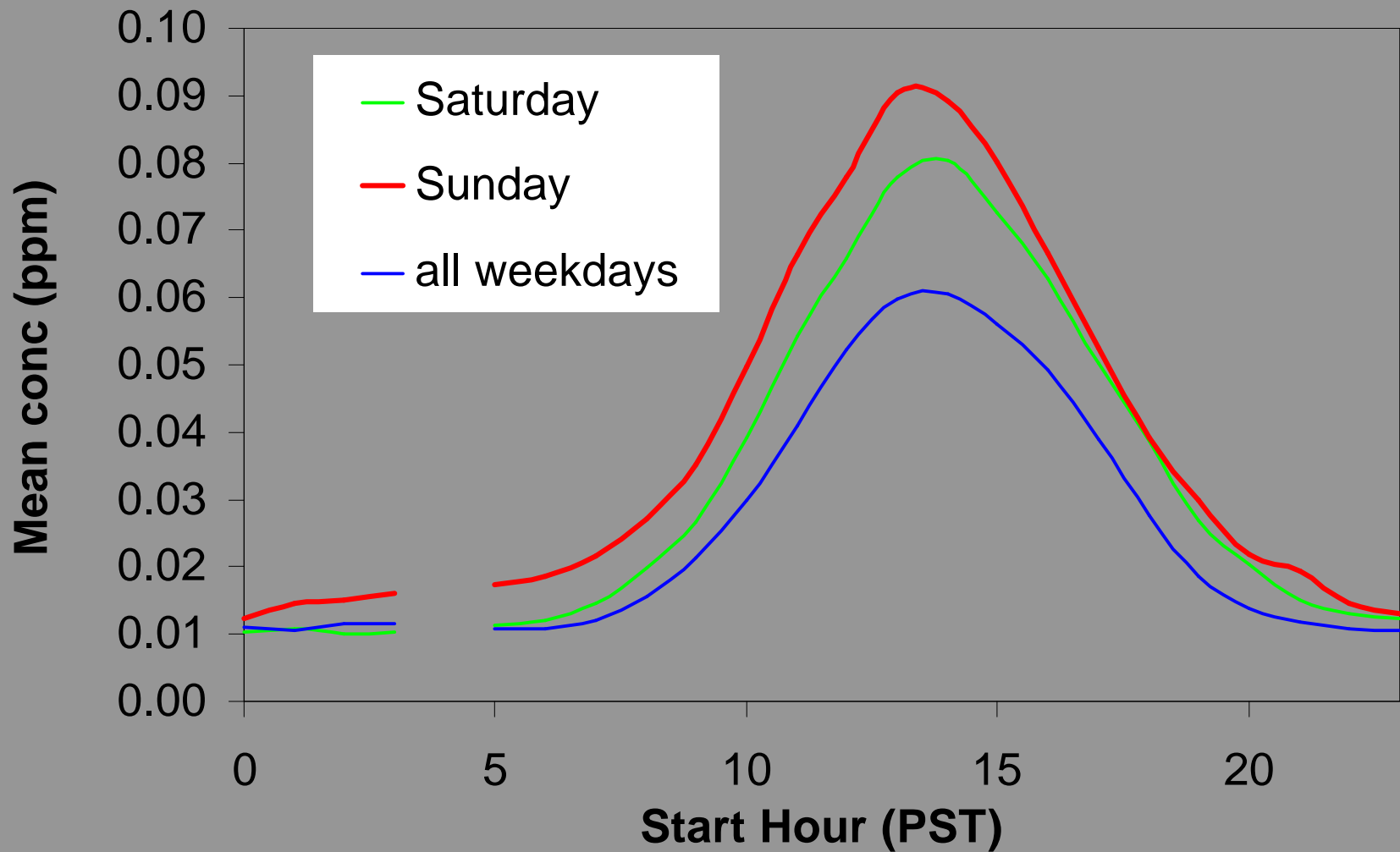
Ozone 1998

- Sunday peak highest, then Saturday, then weekdays
- Sunday diverges from other days in early AM
- Weekend days peak later than weekday in San Bernardino and Riverside
- Long distance transport sites have characteristic profile

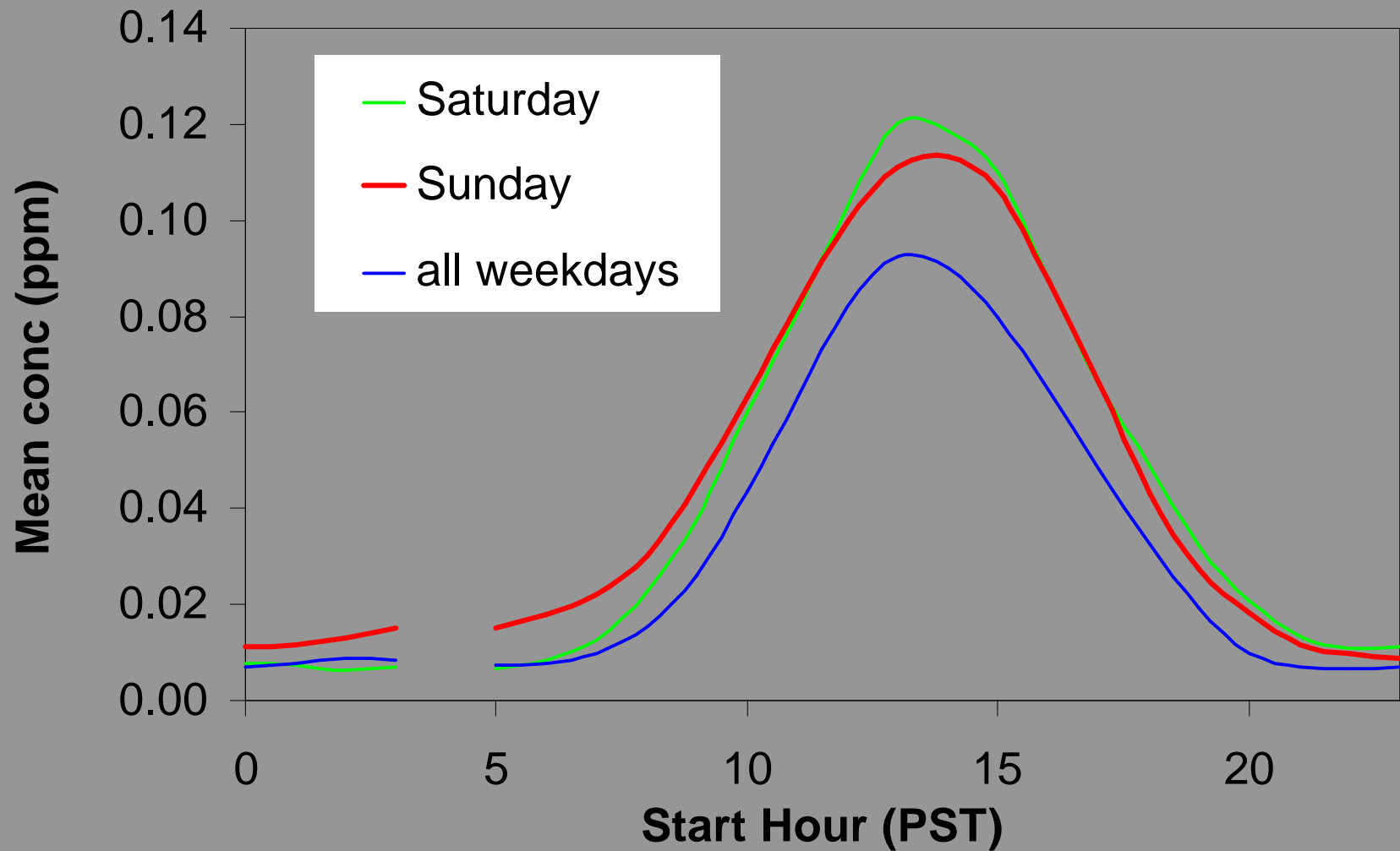
Ozone 1994

- Peak concentrations higher
- Late San Bernardino and Riverside weekend peak timing shift not evident
- Saturday usually highest

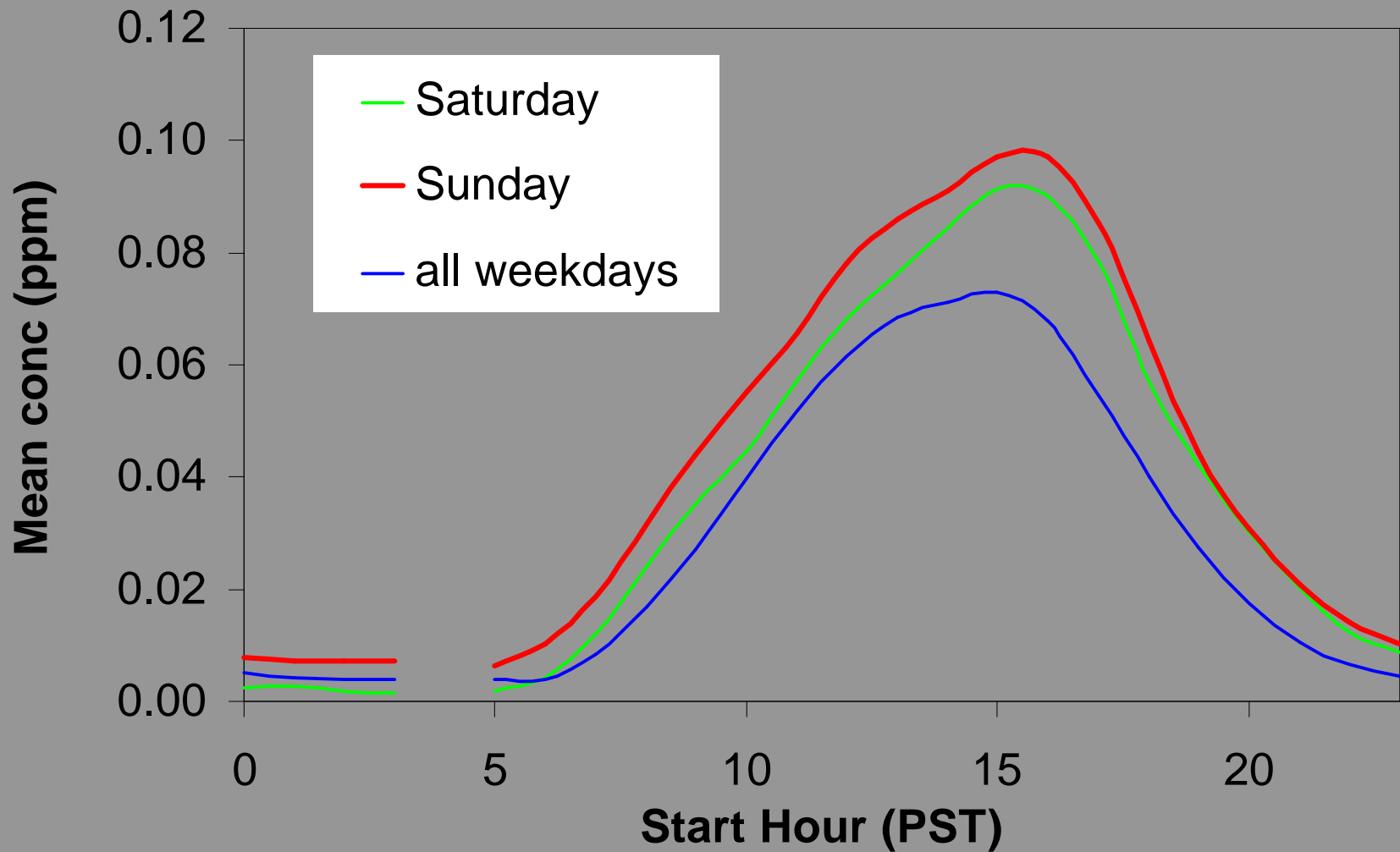
Mean diurnal ozone profile Azusa, May-October, 1998



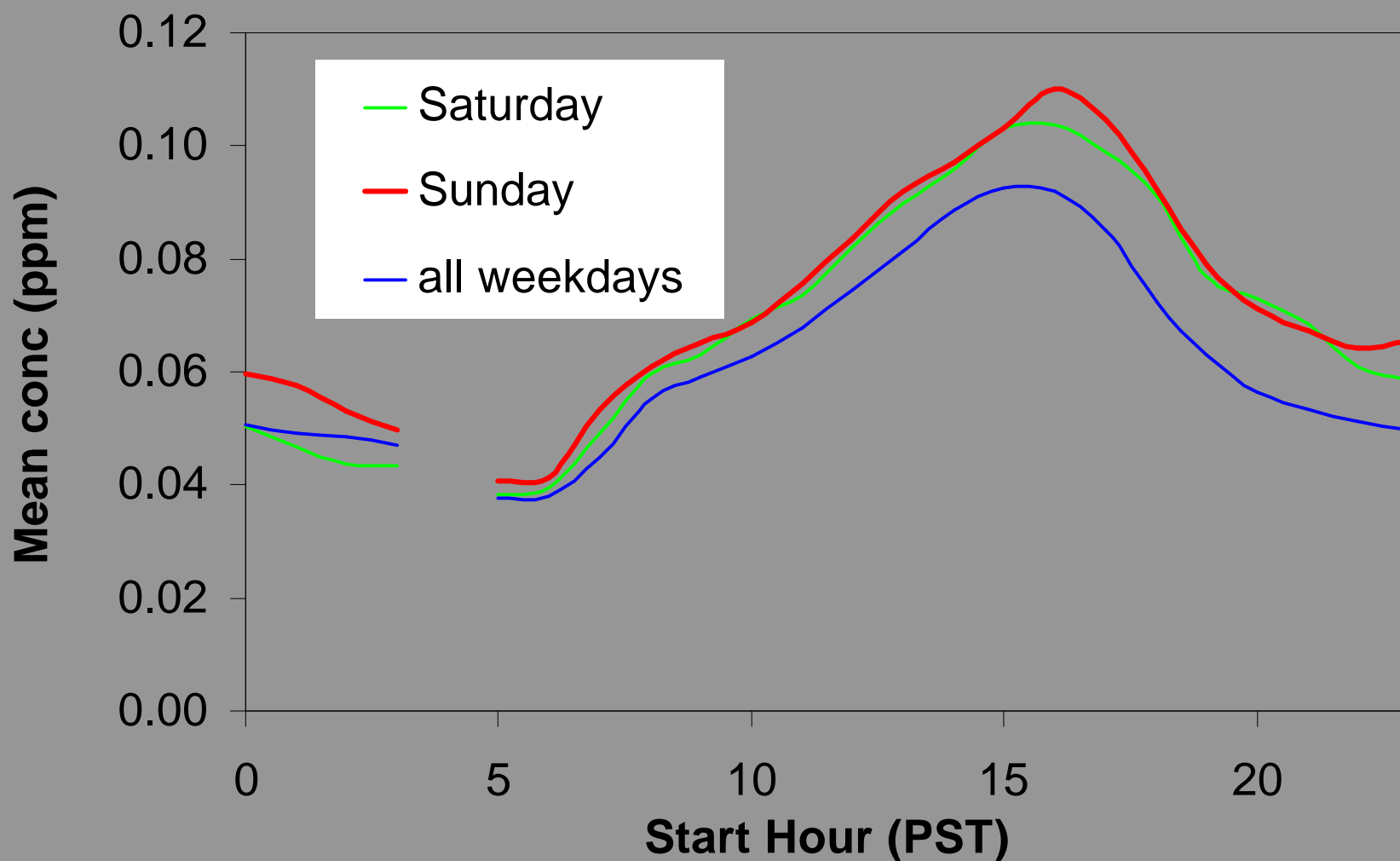
Mean diurnal ozone profile Azusa, May-October, 1994



Mean diurnal ozone profile San Bernardino, May-October, 1998



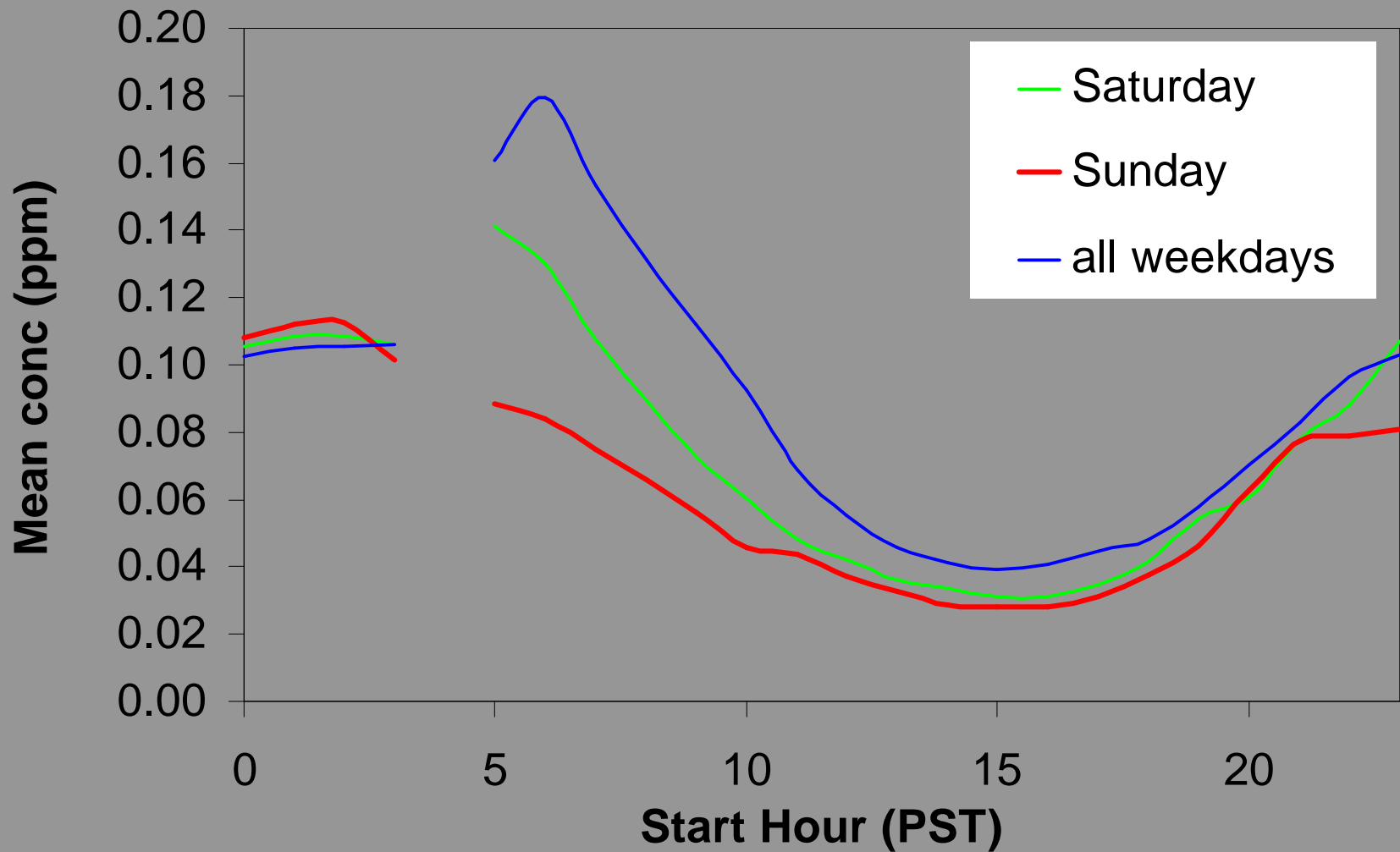
Mean diurnal ozone profile Lake Gregory, May-October, 1998



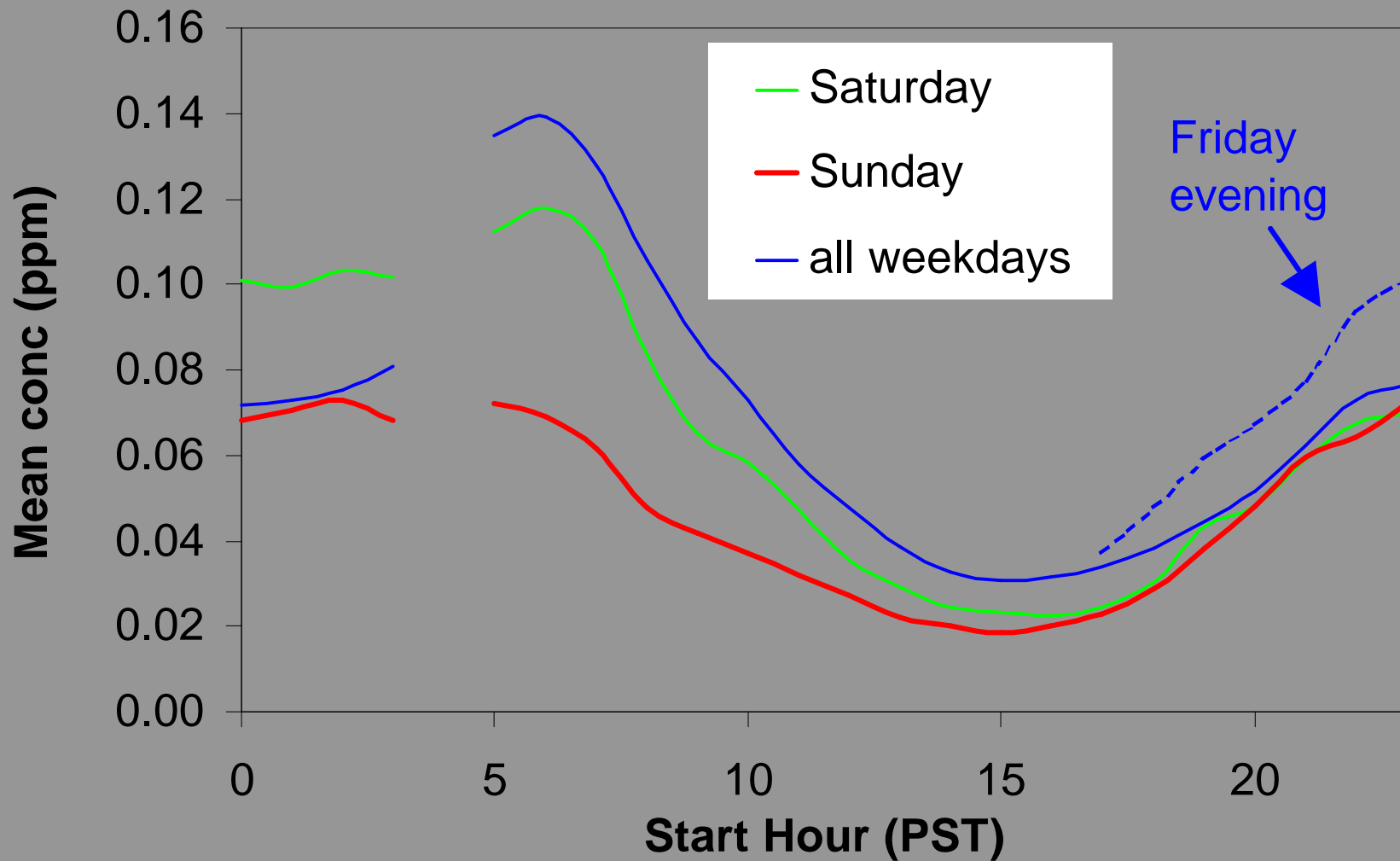
Oxides of nitrogen

- Shapes of profiles for different sites and years are similar
- Weekdays highest, then Saturday, then Sunday
- Elevated Friday evening / Saturday morning concentrations at many sites
- In 1994, higher concentrations and smaller "Friday effect"

Mean diurnal NOx profile Los Angeles, May-October, 1994



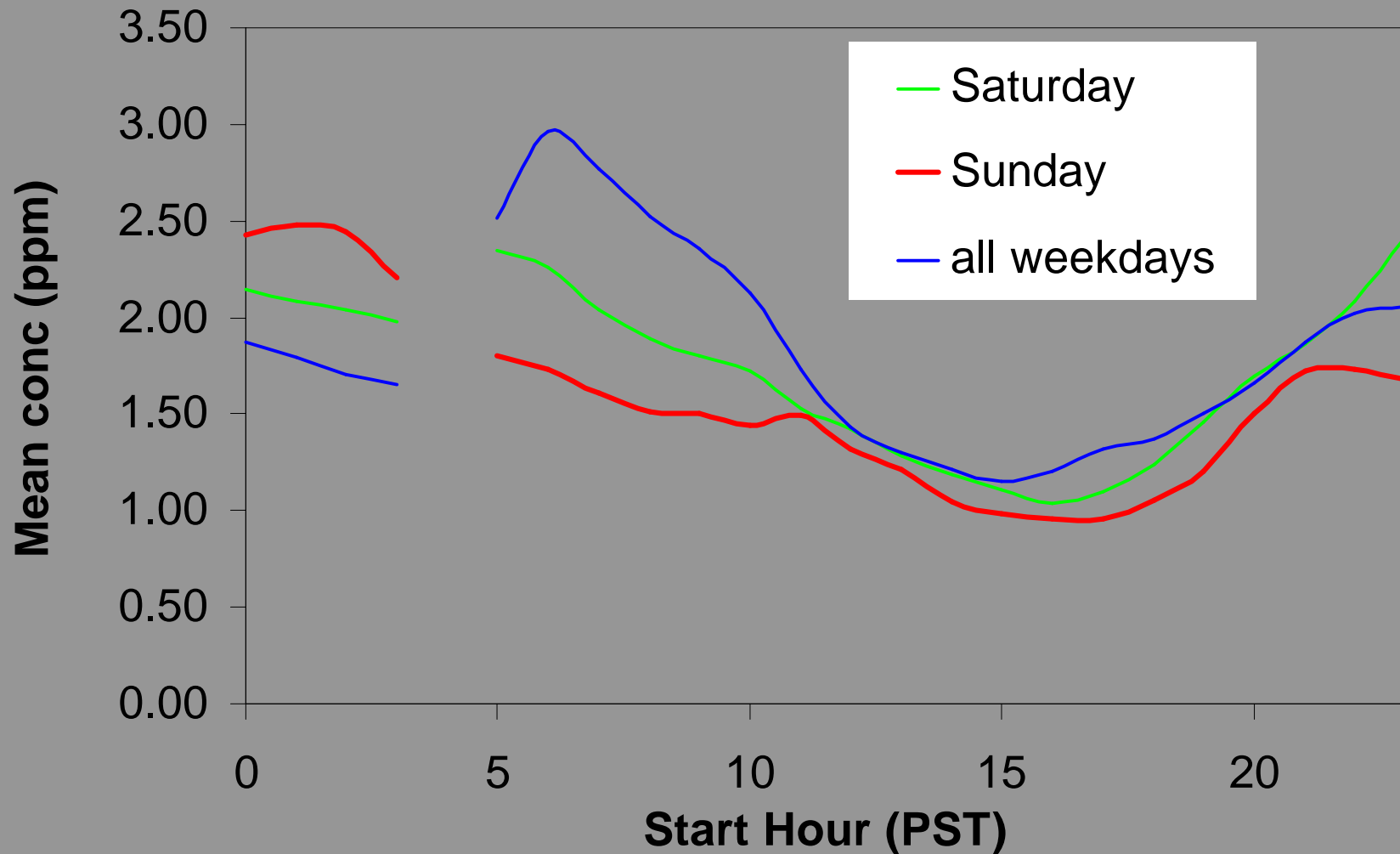
Mean diurnal NOx profile Los Angeles, May-October, 1998



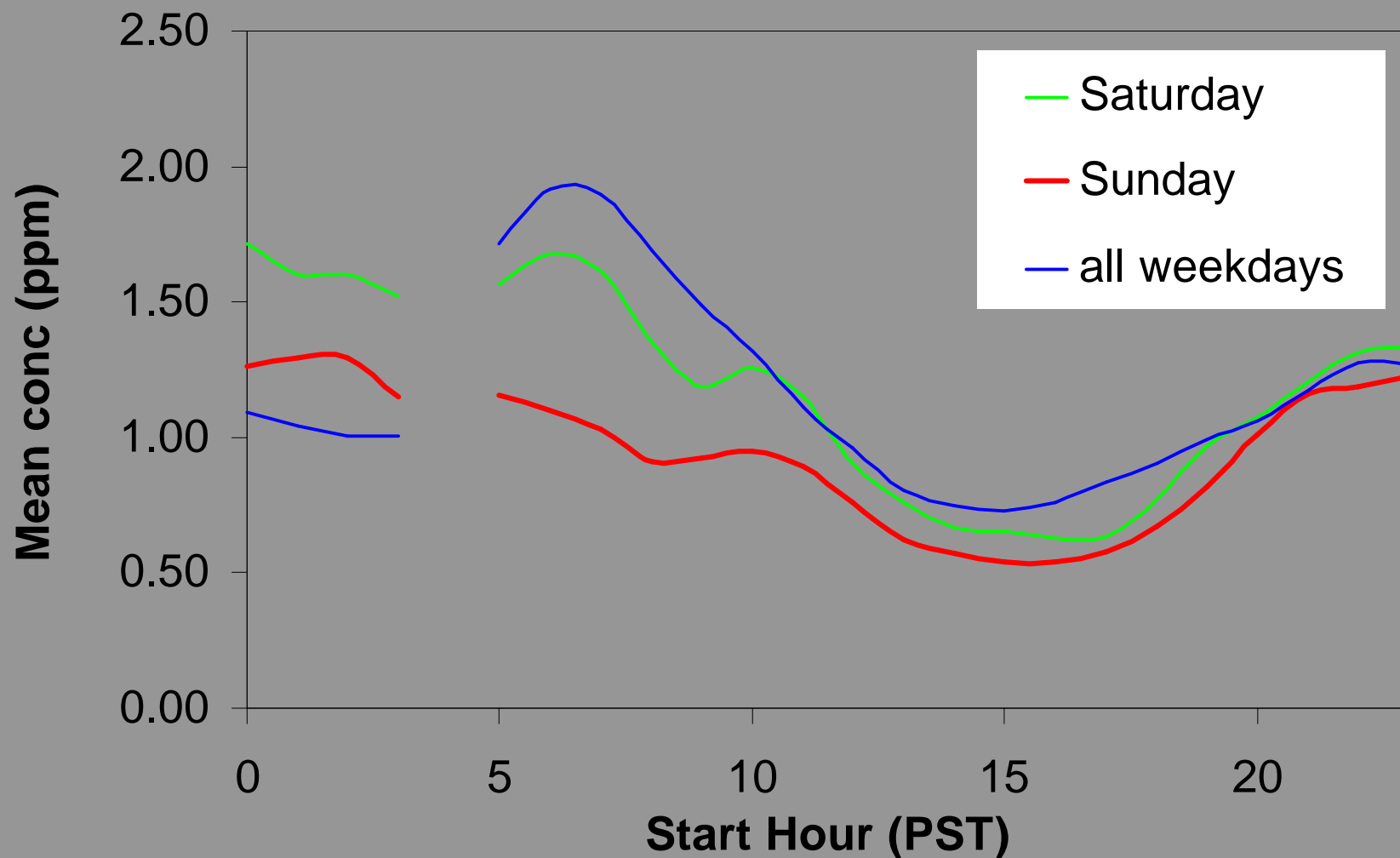
Carbon Monoxide

- Shapes of profiles are similar to NO_x
- Differences from NO_x:
 - » Weekend often high in early AM
 - » Friday evening effect not as strong as for 1998 NO_x profiles
- Lynwood is unusual in 1998 – high Saturday afternoon concentrations

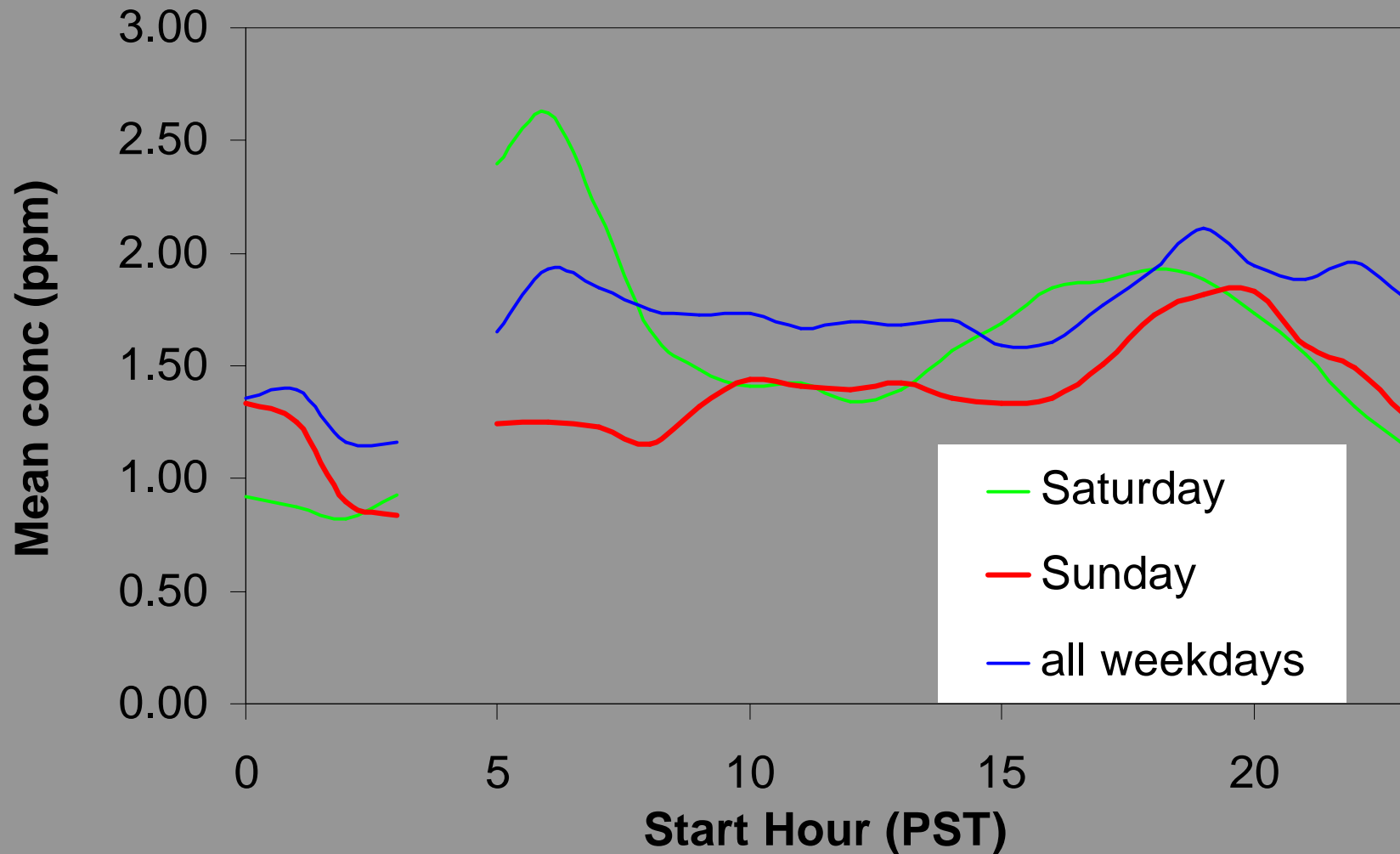
Mean diurnal CO profile Los Angeles, May-October, 1994



Mean diurnal CO profile Los Angeles, May-October, 1998



Mean diurnal CO profile Lynwood, May-October, 1994



Conclusions

- Patterns are suggestive, but no definitive conclusions as to cause and effect
- Possibilities for future research
 - » Add other years, regions
 - » Compute HC profiles
 - » Study relationship between ambient diurnal precursor profiles and traffic flow

Weekday - Weekend Differences in Hydrocarbon Reactivity

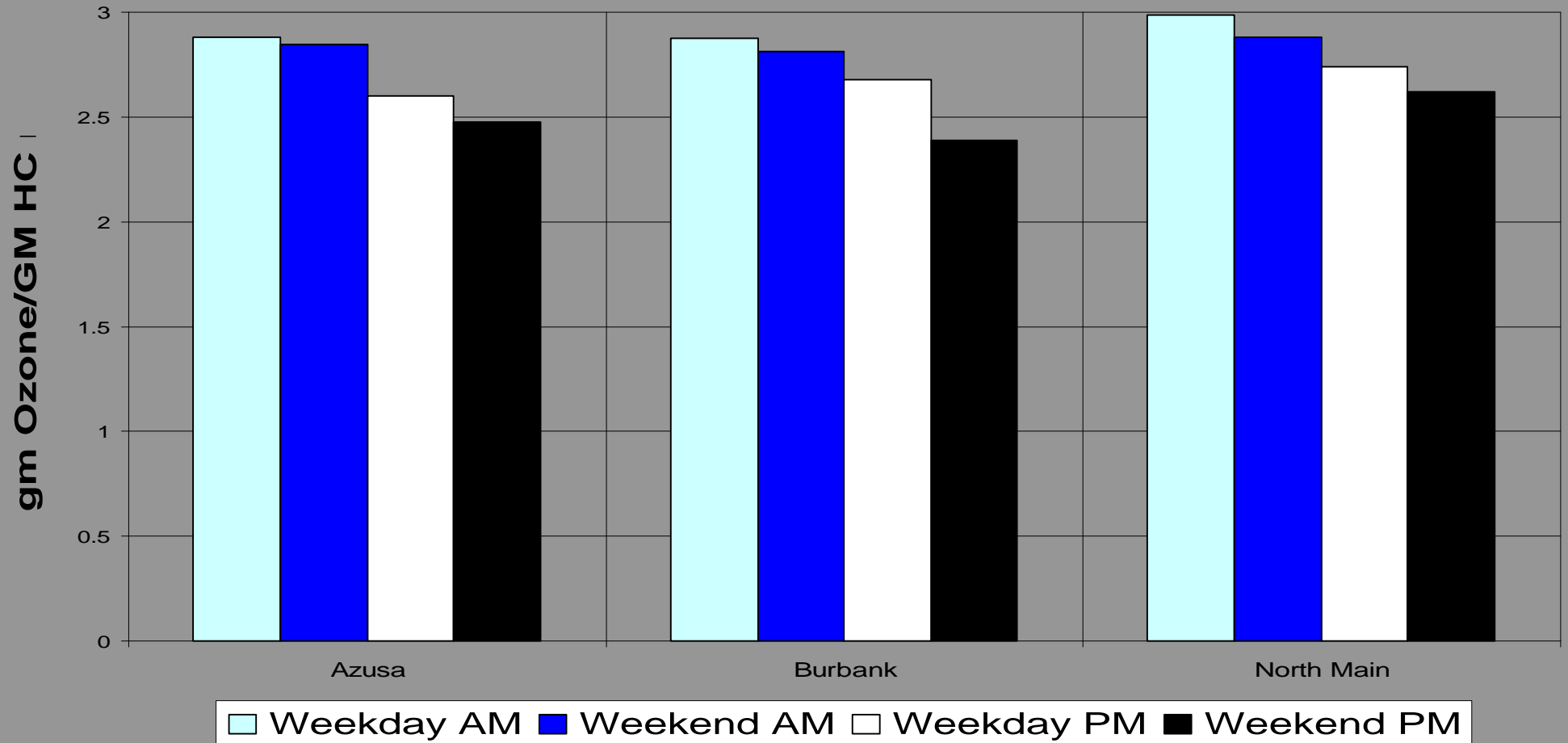
Randy Pasek
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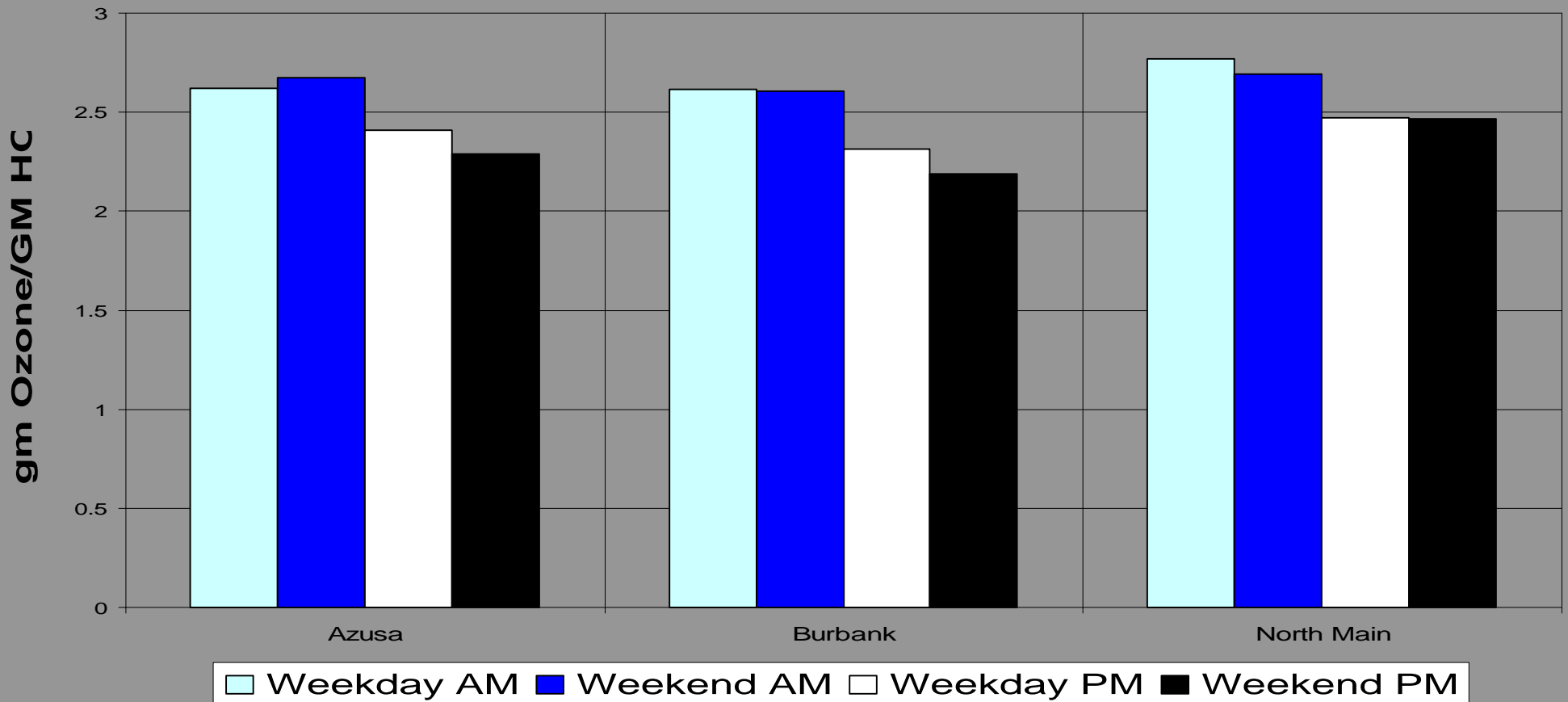
Results

- Reactivity decreased between 1995 and 1996
- Weekend reactivity slightly lower than weekdays
- Differences in WD and WE reactivity seem greatest in PM

1995 Reactivity



1996 Reactivity



Possible further study

- Statistical analysis to assess significance of changes
- Similar analysis on PAMS data
- Determine if improved HC measurements are needed

The Day-of-Week Pattern of PM10, South Coast, 1987-1998

Hien Tran
23 June 1999

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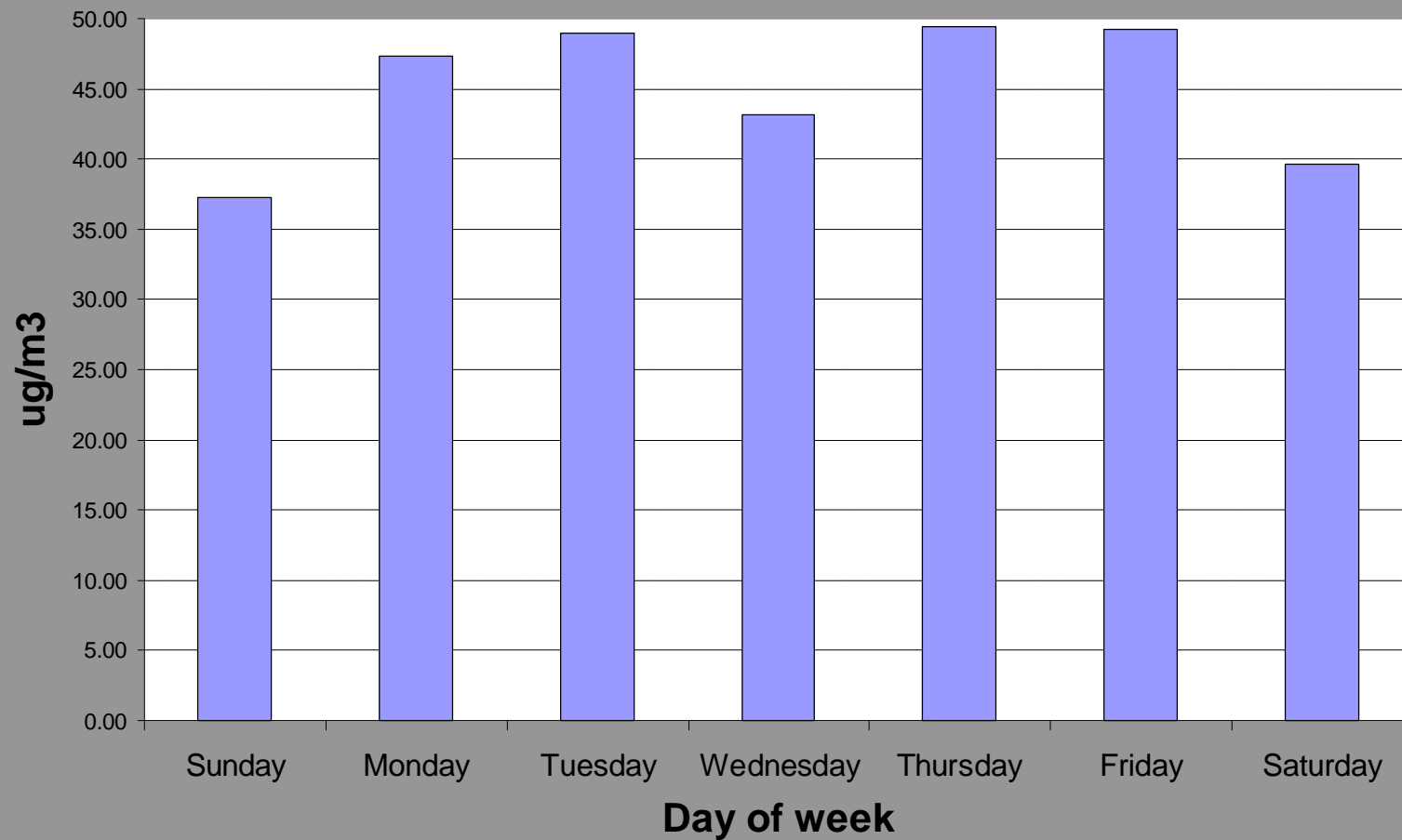
Data and Methods

- PM10 SSI, measured 1 in 6 days
- South Coast: 23 sites
- Time: 1987–1998
- Analysis of variance

Results on PM10 means

- PM10 low during weekend
- PM10 slightly low on Weds.

PM10 by day of week - Azusa



Results on significant differences (5% sign. level)

- 4 sites did not show any differences
- 6 sites: Sunday lower than others except Sat. and Weds.
- Weds. lower than Friday (8 sites) and lower than Thurs. (6 sites)
- 5 sites: Sat lower than Friday

Conclusions

- No clear spatial pattern
- Sunday and Weds PM10 lower than at least one other day at most sites

Possible further study

- Other regions: SFB, Sac Valley
- PM TEOM
- PM species
- PTEP
- Divide time periods (3 or 5 years block)
- Seasons

Discussion on Future Research

June 23, 1999

Bart Croes

Observations

- Ozone Drops for All Days, All Sites
- Ozone Control Program Less Effective on Weekends in SoCAB and SFBAAB
- No Weekend Effect in Sacramento
- PM Higher on Weekdays

Cause and Effect Hypotheses

- “NO_x Disbenefit”
 - » less truck traffic on weekend
 - » less NO_x and soot
- “NO_x Limitation”
 - » similar VMT (but later on weekends)
 - » more ozone production from NO_x
- “Overnight Carryover”
 - » Friday and Saturday night traffic
- “Increased Weekend Emissions”
 - » diurnals, home, recreation

“Increased Weekend Emissions”

- Diurnal Evaporatives
- SUVs
- Friday Gasoline
- Power Generation
- House Painting
- Home Solvents
- Lawn and Garden
- Biogenic VOC
- Motorcycles
- Boats and Jet Skis
- Private Airplanes
- Barbecues
- Fast Food Preparation

Cause and Effect Research

- Complementary Approaches
 - » data analysis
 - » emission activity and inventories
 - » air quality modeling
- Analyze Existing Data by 2000 AQMP
 - » primarily data analysis
 - » SoCAB has most available data
- Analyze New Data by 2003 SIPs
 - » primarily EI and modeling

Air Quality Data Analysis Research

- Characterize WE Effect
 - » ozone, high ozone, PM, trends
- Diurnal Profiles
 - » ozone, NO_x, CO, HC, PM
- Traffic Activity Patterns
- Overnight Carryover
 - » surface, elevated, aloft
- HC Speciation by Day of Week
- Final Report

Emission Inventory Needs

- Monday to Thursday Similar
- Friday, Saturday, Sunday
- Source Information
 - » truck traffic on weekends
 - » diurnals, home, recreation
- Temporal Information
 - » Friday and Saturday night traffic
 - » weekend VMT later in day
- Spatial Information
 - » weekend VMT further downwind